Environmental Justice Analysis for the Proposed Lead and Copper Rule Revisions

Contract # EP-W-17-009

Revised Draft

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Acronyms and Abbreviations

AL	action level
ALE	action level exceedance
BLL	blood lead level
CCT	corrosion control treatment
CDBG	Community Development Block Grant
CI	confidence level
CWS	community water system
DWSRF	Drinking Water State Revolving Fund
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
GWS	Goldsboro Water System
IEUBK	Integrated Exposure and Uptake Biokinetic
IPUMS	Integrated Public Use Microdata Series
IQ	intelligence quotient
LCRR	Lead and Copper Rule Revisions
LMR	lead-bearing material replacement
LSL	lead service line
LSLR	lead service line removal
µg/dL	micrograms per deciliter
MCLG	maximum contaminant level goal
mg/L	milligrams per liter
NHANES	National Health and Nutrition Examination Survey
NPDWR	National Primary Drinking Water Regulations
NTNCWS	non-transient non-community water system
OR	odds ratio
PE	Public education
POU	point-of-use
PUMA	public use microdata area
PWS	public water system
SDWA	Safe Drinking Water Act
WIFIA	Water Infrastructure Finance and Innovation Act
WIIN	Water Infrastructure Improvements for the Nation

Executive Summary

Lead is a highly toxic contaminant that may damage neurological, cardiovascular, immunological, developmental, and other major body systems (USEPA, 2013). No safe level of lead exposure has been identified. Children are at higher risks from the effects of lead than adults because of differences in physiology and behavior (USEPA, 2013). Health risks among children include a range of neurological effects, including decreases in intelligence and increases in attention problems. Health risks among adults include increased risk of cardiovascular mortality (USEPA, 2013).

The U.S. Environmental Protection Agency developed the proposed Lead and Copper Rule Revisions (LCRR) to reduce exposure to lead and copper in drinking water. Lead does not naturally occur in drinking water. Instead, lead comes from lead pipes, faucets, and fixtures. It can dissolve in water that passes through plumbing systems or enter water as flakes or small particles. To keep lead from entering the water, EPA requires some water systems to treat water using chemicals that keep the lead in place by reducing corrosion. This type of treatment is called corrosion control. When corrosion control alone is not sufficient to control lead exposure, EPA requires systems to educate the public about risks of lead in drinking water and to replace lead service lines.

The proposed LCRR would improve the protection of public health by reducing exposure to lead in drinking water. The proposed LCRR would strengthen procedures and requirements related to health protection and the implementation of the existing Lead and Copper Rule (LCR) in the following areas: lead tap sampling; corrosion control treatment; lead service line replacement; consumer awareness; and public education. The proposed LCRR includes new requirements for community water systems to conduct testing for lead in drinking water and conduct public education in schools and child care facilities. The proposed LCRR does not include revisions to the copper requirements of the existing LCR.

This report provides the results of an evaluation of the impact of the proposed LCRR from an environmental justice perspective. The evaluation addresses the following three questions recommended in the *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis* (USEPA, 2016a):

- Are there potential environmental justice concerns associated with environmental stressors affected by the regulatory action for population groups of concern in the baseline?
- Are there potential environmental justice concerns associated with environmental stressors affected by the regulatory action for population groups of concern for each regulatory option under consideration?
- For each regulatory option under consideration, are potential environmental justice concerns created or mitigated compared to the baseline?

Exhibit ES-1 provides a summary of the evaluation topics, methods, and findings.

Exhibit ES-1. Summary of Environmental Justice Evaluation Topics, Methods, and Findings.

Evaluation Topic	Evaluation Method	Findings
Are population groups of concern (e.g., minority and low-income populations) disproportionately exposed to lead and copper in drinking water delivered by water systems?	Case study of blood lead levels and minority status Statistical analysis of child income, minority status, and housing vintage (proxy for lead service lines)	Higher blood lead levels observed among minority populations Higher proportion of low-income children in older housing likely to have lead service lines
Are minority and low-income populations disproportionately affected by the proposed LCRR?	Illustrative estimates and discussion of health risk reductions for rule provisions	System-wide changes that benefit all customers will also benefit minority and low-income populations. Household-level changes that depend on ability-to-pay will leave low-income households with disproportionately higher health risks
Do the proposed LCRR effects create or mitigate baseline environmental justice concerns?	Qualitative discussion of how revisions might affect minority or low-income households with baseline disproportionate risk	In general, the proposed LCRR should reduce health risks primarily at systems with lead service lines, which could address baseline disproportionate risk

1. Introduction

To provide technical support to the U.S. Environmental Protection Agency (EPA or Agency), Abt Associates evaluated the environmental justice implications of the proposed Lead and Copper Rule Revisions (LCRR), which would reduce exposure to lead in drinking water. EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA, 2016a, p. 1). The EPA further defines the term "fair treatment" to mean that "no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies" (USEPA, 2014, p. 3). Finally, the EPA notes that for analytical purposes, a potential environmental justice concern refers to "disproportionate and adverse impacts on minority populations, low-income populations, and/or indigenous peoples that may exist prior to or that may be created by the proposed regulatory action" (USEPA, 2015, p. 10).

The framework for evaluating the impact of a Proposed LCRR on environmental justice comes from the three questions recommended in the *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis* (USEPA, 2016a):

- Are there potential environmental justice concerns associated with environmental stressors affected by the regulatory action for population groups of concern in the baseline?
- Are there potential environmental justice concerns associated with environmental stressors affected by the regulatory action for population groups of concern for each regulatory option under consideration?
- For each regulatory option under consideration, are potential environmental justice concerns created or mitigated compared to the baseline?

Applying these questions to the proposed LCRR, the EPA evaluated the following research questions:

- Are population groups of concern (e.g., minority populations and low-income populations) disproportionately exposed to lead and copper in drinking water delivered by drinking water systems?
- Are population groups of concern disproportionately affected by the proposed LCRR?
- Do the disproportionate effects – if any – create or mitigate baseline environmental justice concerns?

1.1 Background

EPA is revising the National Primary Drinking Water Regulation (NPDWR) established for lead under the Lead and Copper Rule (LCR) to improve public health protection by reducing exposure to lead in drinking water. Under the Safe Drinking Water Act (SDWA), EPA establishes a non-enforceable health-based maximum contaminant level goal (MCLG). Because there is no known safe level of lead in drinking water, the MCLG for lead is zero. EPA also establishes NPDWRs using either an enforceable maximum contaminant level (MCL) or a treatment technique to protect public health. The LCR is a treatment technique rule. For lead, it includes an action level (AL) of 0.015 milligrams per liter (mg/L) [15 parts per billion (ppb)] for lead, based on the 90th percentile of the distribution of tap samples collected at customer locations having lead service lines (LSLs), lead soldered copper piping, or plumbing materials representative of those found in the distributions system. In the event of an action level exceedance (ALE) the system is required to conduct a number of actions to reduce customer lead exposure.

Tap sampling is necessary because lead is generally not present in source water at levels of concern (i.e., surface water or ground water used as drinking water sources). Instead, lead enters drinking water when the water comes into contact with service lines, pipes, and fixtures that contain lead. Therefore, the regulations require public water systems (PWSs) that are either community water systems (CWSs) or non-transient non-community water systems (NTNCWSs) to monitor water quality at customer taps.[1] If the 90th percentile of the samples exceeds an AL of 0.015 mg/L for lead, then a system must implement corrosion control treatment if it is not already in place, conduct source water monitoring/treatment, conduct PE, and/or lead service line replacement (LSLR) in the distribution system.

The use of materials that have the potential to increase lead concentrations in drinking water have generally declined over time. Statutory and regulatory changes over time have reduced the presence of lead in potable water and plumbing materials.

1.2 Lead and Copper Regulation

The EPA promulgated MCLGs and a treatment technique standard for lead and copper – including the ALs – on June 7, 1991 (USEPA, 1991). The EPA proposed minor revisions to the NPDWRs in 1996 (USEPA, 1996) and finalized these minor revisions on January 12, 2000 (USEPA, 2000), and again proposed minor revisions on July 18, 2006 (USEPA, 2006) and finalized them on October 10, 2007 (USEPA, 2007). None of these revisions affected the AL, MCLG, or the rule's basic requirements. Rather, they clarified or revised elements such as tap monitoring requirements and notification requirements.

Other legislation affecting lead content includes the 1986 Amendments to the SDWA (42 U.S.C. 300g-6), which, after June 19, 1986, prohibited the use of materials that were not lead free in potable use applications [section 1417 (a)] and defined lead-free materials [section 1417 (d) (1) – (3)], including limiting the lead content in pipe and pipe fittings to 8.0 percent lead content. Subsequent legislation – the 2011 Reduction of Lead in Drinking Water Act – further reduced the allowable lead content in potable use materials to a weighted average of 0.25 percent with respect to wetted surfaces, effective January 4, 2014.

Although new LSLs could not be installed after 1986, millions of old LSLs remain in service. The number of LSLs installed prior to 1986 is unknown as is the number of lead service lines that remain in service today. Based on a survey of utilities throughout the nation, Cornwell et al. (2016) estimated that there were about 6.1 million lead service lines serving 15 to 22 million people in service.

1. A PWS provides water for 15 or more service connections or serves 25 or more of the same people at least 60 days a year. A CWS is a PWS that serves its population year-round. Non-CWSs do not serve customers year-round, but NTNCWSs serve 25 or more of the same people at least 6 months of the year (e.g., schools).

The proposed LCRR would strengthen public health protection and improve implementation of the regulation in the following areas: lead tap sampling; corrosion control treatment (CCT); lead service line replacement (LSLR); consumer awareness; and public education (PE).

1.3 Document Outline

This report contains the following:

- Section 2 discusses baseline environmental justice concerns, including providing case study evidence of proportionally higher health risks of lead in drinking water among minority and/or low-income populations, and an analysis of national demographic data
- Section 3 provides a qualitative review of the proposed LCRR with respect to environmental justice concerns, including whether the regulatory requirements are expected to address or exacerbate any baseline concerns
- Section 4 provides a summary of the overall environmental justice implications of baseline conditions and the potential effect of the proposed LCRR with respect to lead in drinking water.

2. Baseline Lead and Copper Exposure

EPA's environmental justice evaluation framework first requires a review of whether baseline conditions give rise to environmental justice concerns. In the case of lead and copper in drinking water, the key question is whether minority populations and/or low-income populations bear disproportionate health risks of exposure to lead and copper through drinking water. There are two factors to consider. First, are these populations more likely to have higher concentrations of lead and copper in their drinking water (i.e., is their marginal exposure to lead and copper in drinking water higher)? Second, are these populations likely to have higher exposure to lead and copper from other sources (i.e., is their overall exposure higher because of other sources of lead and/or copper)?

In the following sections, we focus on exposures to lead rather than to copper. In Sections 2.1 and 2.2, we discuss the health risks and routes of exposure to lead. Next, in Sections 2.3 to 2.5, we provide evidence of differential exposures to lead in environmental justice populations.

2.1 Health Risks of Lead Exposure

USEPA (forthcoming) describes the health risks of lead exposure as follows:

> Exposure to lead is known to present serious health risks to the brain and nervous system of children. Lead exposure causes damage to the brain and kidneys and can interfere with the production of red blood cells that carry oxygen to all parts of the body. Lead has acute and chronic impacts on the body. The most robustly studied and most susceptible subpopulations are the developing fetus, infants, and young children. Even low level lead exposure is of particular concern to children because their growing bodies absorb more lead than adults do, and their brains and nervous systems are more sensitive to the damaging effects of lead. The EPA estimates that drinking water can make up 20 percent or more of a person's total exposure to lead (56 FR 26548, June 7, 1991). Infants who consume mostly mixed formula made from tap water can, depending on the level of lead in the system and other sources of lead in the home, receive 40 percent to 60 percent of their exposure to lead from drinking water used in the formula. Scientists have linked lead's effects on the brain with lowered IQ and attention disorders in children. During pregnancy, lead exposure may affect prenatal brain development. Lead is stored in the bones and it can be released later in life. Even at low levels of lead in blood, there is an increased risk of health effects in children (e.g., <5 micrograms per deciliter) and adults (e.g., <10 micrograms per deciliter).
>
> The 2013 Integrated Science Assessment for Lead (USEPA, 2013) and the U.S. Department of Health and Human Services' National Toxicology Program Monograph on Health Effects of Low-Level Lead (National Toxicology Program, 2012) have both documented the association between lead and adverse cardiovascular effects, renal effects, reproductive effects, immunological effects, neurological effects, and cancer. The EPA's Integrated Risk Information System (IRIS) Chemical Assessment Summary provides additional health effects information on lead (USEPA, 2004a). For a more detailed explanation of the health effects associated with lead for children and adults see Appendix D of the Economic Analysis (reference EA).

2.2 Routes of Exposure to Lead

Individuals are commonly exposed to lead via ingestion and inhalation. Dermal exposure to lead is not a primary route of exposure in the general U.S. population (ATSDR, 2007). Ingestion of lead can occur from multiple sources. Drinking water may be a significant source of lead exposure for individuals who live or work in buildings with LSLs and other plumbing fixtures that contain lead (ATSDR, 2007). Ingestion of certain foods – particularly those that may be grown in lead-contaminated soils, such as fruits and vegetables – is another source of exposure to lead (ATSDR, 2007). Contaminated soils can also result in lead exposures directly via incidental ingestion or inhalation of soils (ATSDR, 2007). Deteriorating lead-based paint in homes can also form chips that may be directly ingested by infants and children (ATSDR, 2007). Lead paint removal or sanding can also result in inhalation of contaminated dust. Additionally, along with lead-based paint, soil lead contributes to the contamination of indoor dust lead (ATSDR, 2007). As is the case with soil, dust may be incidentally ingested or inhaled (ATSDR, 2007). Although lead concentrations in ambient air have decreased in recent years, the inhalation of air is another source of exposure to lead, particularly near point sources (e.g., factories that emit lead; USEPA, 2013).

Routes of exposure to lead can depend on life stage and other factors. Because infants and children exhibit hand-to-mouth behaviors, they are likely to be exposed to lead via household dust. This is a primary route of exposure to lead dust in the majority of U.S. children (USEPA, 2013). Prenatal exposures to lead can also occur, particularly as a result of biological changes in pregnancy that increase the chances of lead being released from maternal bones and transferred to fetuses (ATSDR, 2007). The maternal transfer of lead can also occur during breastfeeding (ATSDR, 2007). Adults working in industries that use lead may be exposed to it through dermal pathways (ATSDR, 2007). Cigarette smoking can also increase exposures to lead (Jain, 2016).

2.3 Drinking Water Lead Exposure as an Environmental Justice Issue

The best available national data that characterize exposure to lead in drinking water are the monitoring data collected by EPA. As noted above, systems collect samples from household taps and aggregate the results, reporting a 90th percentile to their primacy agencies. EPA collects these values and makes them publicly available via the federal version of the Safe Drinking Water Information System. While these data are useful in identifying action level exceedances (ALEs), historical tap sampling practices may not have identified ALE in water systems. However, the improved sampling, monitoring, and reporting required under the proposed LCRR would better identify areas of concern. Unfortunately, there is no national database of LSL locations or other lead sources in home plumbing. To identify potential LSL locations, the analysis examines housing construction year or age, a broad indicator of potential lead plumbing exposure, along with other cumulative lead risks.

Abt Associates pursued the following routes of inquiry:

- We searched the literature for information on blood lead levels in environmental justice populations, as well as case studies on the impact of changes in drinking water lead exposure among children in different demographic groups (Section 2.4).
- We reviewed national demographic and housing age data to determine if there are patterns that suggest potential for a baseline environmental justice concern. One of the main sources of lead in drinking water is the presence of LSLs, and – because older housing is more likely to have LSLs than newer housing – housing vintage is a useful indicator of the potential risk of exposure to lead in

drinking water. Housing vintage is also related to the presence of lead-based paint, which is both a confounding factor in efforts to detect a relationship between blood lead levels and drinking water exposure, and an exacerbating risk factor if minority and/or low-income populations disproportionately live in older housing units that have both lead paint and LSLs (Section 2.5).

2.4 Research on Lead Exposure in Environmental Justice Populations

We searched the literature for evidence of disparities in blood lead levels between environmental justice populations and the general U.S. population. Prior research on blood lead levels has shown that environmental justice factors such as race and income tend to impact levels of exposure. Based on available data, it is usually not possible to apportion these differences in blood lead to exposure from a specific source (e.g., drinking water lead). Nevertheless, the research demonstrates that there are pre-existing disparities in lead exposure. Because of these pre-existing differences, the same marginal increase in drinking water lead exposure may be more likely to result in adverse health effects, or in blood lead levels that exceed the Centers for Disease Control and Prevention’s level of concern of 5 micrograms per deciliter (µg/dL).

2.4.1 General Literature

Non-white race has been identified as a risk factor for elevated blood lead levels in numerous studies. White et al. (2016) conducted a systematic review of the literature on racial and ethnic differences in blood lead levels of children under 6 years old. In all identified studies that examined mean blood lead levels in children of different races, black children had higher blood lead levels than children of white or Hispanic descent (White et al., 2016). For example, in an analysis of National Health and Nutrition Examination Survey (NHANES) 1999–2004 data, Jones et al. (2009) found that black children had significantly higher blood lead levels than white and Mexican-American children: 2.58 µg/dL as compared to 1.7 µg/dL and 1.9 µg/dL, respectively. Likewise, black children were more likely than other ethnic groups to have elevated blood lead levels (White et al., 2016). Munter et al. (2005) examined NHANES 1999–2002 data on U.S. adults and found that the odds of having very high blood lead levels (defined as 10 µg/dL) were significantly higher for non-Hispanic black adults [odds ratio (OR): 2.91, 95% confidence interval (CI): 1.74–4.84] and Mexican-American adults (OR: 3.26, 95% CI: 1.83–5.81) than for non-Hispanic white individuals.

Poverty has also been found to be a risk factor for lead exposure. In a recent analysis of blood lead levels in children from a large national clinical laboratory database, McClure et al. (2016) found significant associations between blood lead levels and poverty levels in children. Children living in areas in the highest quintile of poverty level[2] were significantly more likely (OR: 2.85, 95% CI: 2.79–2.91) than children in areas with the lowest levels of poverty to have high blood lead levels (defined as ≥ 5 µg/dL). Similar results were found when comparing the proportion of children with very high blood lead levels (defined as 10 µg/dL) across poverty levels. In an analysis of NHANES 2003–2012 data on children and adolescents aged up to 19 years old, Jain (2016) found that blood lead levels significantly decreased as income increased ($p < 0.01$).

2. Defined as ZIP codes in which ≥ 52.0% of households have a poverty-income ratio below 1.25. The poverty-income ratio is defined as the ratio of income to the federal poverty level. A ratio of 1.00 or lower indicates that a household meets the federal definition of poverty.

Race and income can also interact to affect blood lead levels. Moody et al. (2016) conducted a study of children in metropolitan Detroit. In neighborhoods with the highest levels of poverty, there were no significant differences in blood lead levels between non-Hispanic black and non-Hispanic white children. However, differences in blood lead levels between these groups increased with increasing levels of socioeconomic status (Moody et al., 2016).

Findings of elevated blood lead levels in low-income and minority populations are consistent with research on the lead sources and exposure routes outlined in Section 2.2. For example, data from the 2005 American Housing Survey suggest that non-Hispanic black individuals are more than twice as likely as non-Hispanic whites to live in moderately or severely substandard housing (Leech et al., 2016). Substandard housing is more likely to present risks from deteriorating lead-based paint (White et al., 2016). Additionally, minority and low-income children are more likely to live in proximity to lead-emitting industries and to live in urban areas, which are more likely to have contaminated soils (Leech et al., 2016). Higher maternal blood lead levels can lead to greater releases of lead to fetuses during pregnancy and to babies during lactation (Leech et al., 2016).

2.4.2 Flint – Effect of Change in Water Source on Blood Lead Levels

Events in Flint, Michigan, provide some evidence of a link between water quality and blood lead levels. In 2014, the City of Flint temporarily changed its water source from the Detroit Water and Sewerage Department to the Flint River. Water from the Flint River is highly corrosive, but no corrosion inhibitor was added when the change in water source occurred. Under corrosive conditions, lead is more likely to leach from old LSLs. Increases in water lead levels were observed following the switch (Edwards et al., 2015). To investigate the impact of these increases, Hanna-Attisha et al. (2016) obtained blood lead level data from Flint's Hurley Medical Center for the period before January 1 to September 15, 2013 and after January 15 to September 15, 2015, when the switch in water sources occurred. Children living inside (n = 1,473) and outside (n = 2,202) Flint were included in the study, with the latter group serving as a comparison. Hanna-Attisha et al. (2016) used a geographic information system (GIS) to geocode an address for each child, and to estimate blood lead levels across time throughout the study area. The authors divided Flint into two categories based on water lead sampling maps: *high water lead level Flint* and *lower water lead level Flint*. To examine the impacts on environmental justice populations, Hanna-Attisha et al. (2016) also developed a measure of overall neighborhood-level socioeconomic disadvantage for each area from variables on maternal and social deprivation.

Hanna-Attisha et al. (2016) found a statistically significant increase in the proportion of children in Flint with elevated blood lead levels (defined as > 5 μg/dL) following the switch in water source: 2.4% of children had elevated blood lead levels before the switch and 4.9% after the switch. In the areas of Flint known to have high water lead levels, a larger increase in elevated blood lead levels – from 4.0% to 10.6% – was observed. Statistically significant differences in demographics were observed: African-American children comprised a greater percentage of total children living in *high water lead level Flint* and *lower water lead level Flint* than outside of Flint (76.8%, 67%, and 24.4%, respectively). Children living in Flint also had significantly higher overall socioeconomic disadvantage scores. When Hanna-Attisha et al. (2016) compared pre-switch blood lead data across regions, they found that children living in Flint had a pre-existing disparity in lead exposures: the percentage of children in Flint with elevated blood lead before the switch was 2.4%, whereas it was 0.7% outside of Flint. The Flint case study thus demonstrates that increases in drinking water lead levels can have a disproportionate impact on environmental justice populations.

2.5 National Demographic and Housing Vintage Data

We used two databases to evaluate whether the national data indicated that minority populations or low-income populations have disproportionate health risks of exposure to lead in drinking water. The following sections describe the databases and findings.

2.5.1 EJSCREEN

EPA's EJSCREEN tool (USEPA, 2017a), the Environmental Justice Screening and Mapping Tool, provides a nationally consistent dataset with mapping and screening tools that combine environmental and demographic indicators to aid in screening for environmental justice issues. EJSCREEN includes an indicator for lead paint based on housing age, and for lead in air. There is currently no indicator for LSLs or other lead in drinking water risk factors.

We began by linking the demographic indicators in EJSCREEN to housing vintages in census block aggregate data (Manson et al., 2017). Housing vintage is an indicator for risk of LSLs, lead solder, and leaded brass fixtures (Rabin, 2008). Sandvig et al. (2008) estimated that 50 percent to 75 percent of lead in drinking water comes from LSLs, while the remainder comes from leaded solder, brass/bronze fittings, galvanized piping, faucets, and water meters. LSLs were installed through the 1980s, with decreases in the number of installations in the decades following 1930. Lead solder was used for residential plumbing through the 1980s and, again, this use of lead decreased over time (Rabin, 2008).

EJSCREEN data are publicly available and can be used to examine, on a census block level, the relationship between disadvantaged groups and housing vintage, along with other risk factors such as proximity to industrial sites. However, to gain finer detail regarding housing vintage in this analysis, we used the Integrated Public Use Microdata Series (IPUMS) dataset to link individuals to housing units by age group.

2.5.2 Public Use Microdata Area

Abt Associates further investigated links between disadvantaged groups and housing vintage using microdata from the U.S. Census American Community Survey (Ruggles et al., 2018). These data directly link individuals in different age groups to housing units in different age groups. We weighted counts for each age group by person weight, and compared demographics by public use microdata area (PUMA). PUMA are larger than census blocks, but the direct linkages among individuals, age data, and more detailed housing unit age data provided a more detailed view of linkages between housing age and demographics.

We examined the spatial distribution of housing among minority populations and people living at or below 200% of the federal poverty limit. We calculated the demographic percentages by state and region, and compared these values to the demographic distributions in each housing unit age group in each PUMA.

Exhibit 2-1 shows results based on all population ages. The percent of people with higher incomes (above 200 percent of the poverty level) living in the newest housing units (built 1980 or later) is 2.53 percentage points higher than would be expected given demographic averages at the state or regional level. The higher income minority population is unlikely to live in the oldest housing – especially units built in 1939 and earlier (-3.68). Low-income households are disproportionately more likely to live in older housing. In particular, white, non-Hispanic, low-income populations are disproportionately living in housing built before 1950 (ranging from 3.94 to 4.03).

Exhibit 2-1. Percent Difference from Equal Distribution by Housing Age for Population of All Ages.

Population Poverty and Race/ Ethnicity Status	Housing Built 1939 or Earlier	Housing Built 1940–1949	Housing Built 1950–1959	Housing Built 1960–1969	Housing Built 1970–1979	Housing Built 1980 or Later
Above 200% poverty level	**-5.07**	**-6.02**	**-3.47**	**-3.88**	**-4.27**	**2.53**
Minority	-3.68	-1.93	-1.75	-1.50	-1.41	1.36
White, non-Hispanic	-1.39	-4.09	-1.72	-2.38	-2.86	1.18
At or below 200% poverty level	**5.07**	**6.02**	**3.47**	**3.88**	**4.27**	**-2.54**
Minority	1.13	1.98	0.92	2.13	2.61	-0.71
White, non-Hispanic	3.94	4.03	2.55	1.75	1.66	-1.83

Note: A negative difference indicates that the demographic group has fewer individuals living in a housing vintage than expected if the housing distribution equaled state demographic averages.

Source: IPUMS (Ruggles et al., 2018).

Exhibit 2-2 shows the same type of results for children under the age of 12. Children in higher income households are more likely to live in newer housing than older housing. Children in low-income households live disproportionately in older housing, with white, non-Hispanic having the highest percent differentials in the housing built prior to 1950.

Exhibit 2-2. Percent Difference from Equal Distribution by Housing Vintage for Children Age 12 and Under.

Population Poverty and Race/ Ethnicity Status	Housing Built 1939 or Earlier	Housing Built 1940–1949	Housing Built 1950–1959	Housing Built 1960–1969	Housing Built 1970–1979	Housing Built 1980 or Later
Above 200% poverty level	-3.93	-5.90	-4.14	-5.47	-6.64	4.75
Minority	**-3.33**	**-2.48**	**-1.97**	**-2.24**	**-2.04**	**1.72**
White, non-Hispanic	**-0.60**	**-3.42**	**-2.17**	**-3.23**	**-4.60**	**3.03**
At or below 200% poverty level	3.93	5.90	4.14	5.47	6.64	-4.75
Minority	**-0.01**	**1.83**	**0.98**	**3.41**	**4.20**	**-2.82**
White, non-Hispanic	**3.93**	**4.07**	**3.16**	**2.06**	**2.44**	**-1.93**

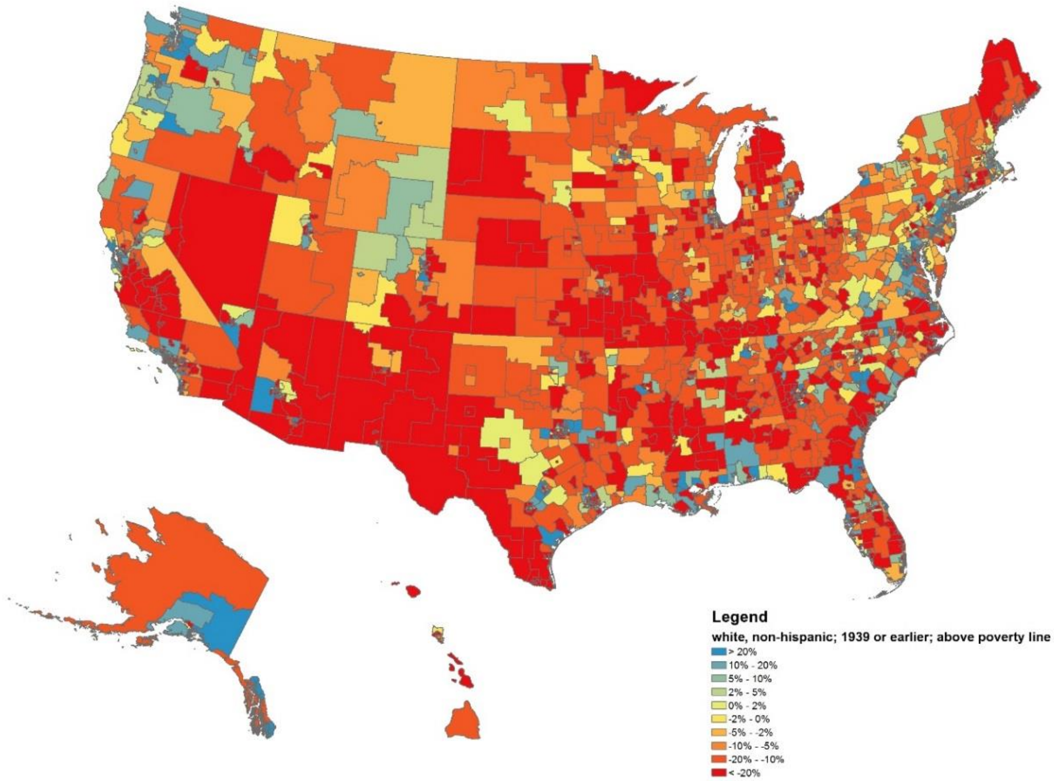
A negative difference indicates that the demographic group has fewer individuals living in a housing vintage than expected if the housing distribution equaled state demographic averages.

Source: IPUMS (Ruggles et al., 2018).

Exhibit 2-3 is a heat map showing where children age 12 and under who are minorities and/or impoverished tend to disproportionately live in the oldest housing units (1939 or older). Areas that are dark red indicate frequencies that are 20 percentage points higher than expected. At the other end of the spectrum, blue areas indicate where white/non-Hispanic children who are not impoverished disproportionately reside in older housing units.

The large PUMA regions reflect areas with low density populations, which may be rural areas with populations served by either small ground water PWSs or individual wells. The urban areas with larger PWSs are not readily visible at this scale. Therefore, isolating the PUMA regions that contain urban areas known to have LSLs may provide more reliable information.

Exhibit 2-3. Percent Difference from Equal Distribution in Oldest Housing Units for Children Age 12 and Under.

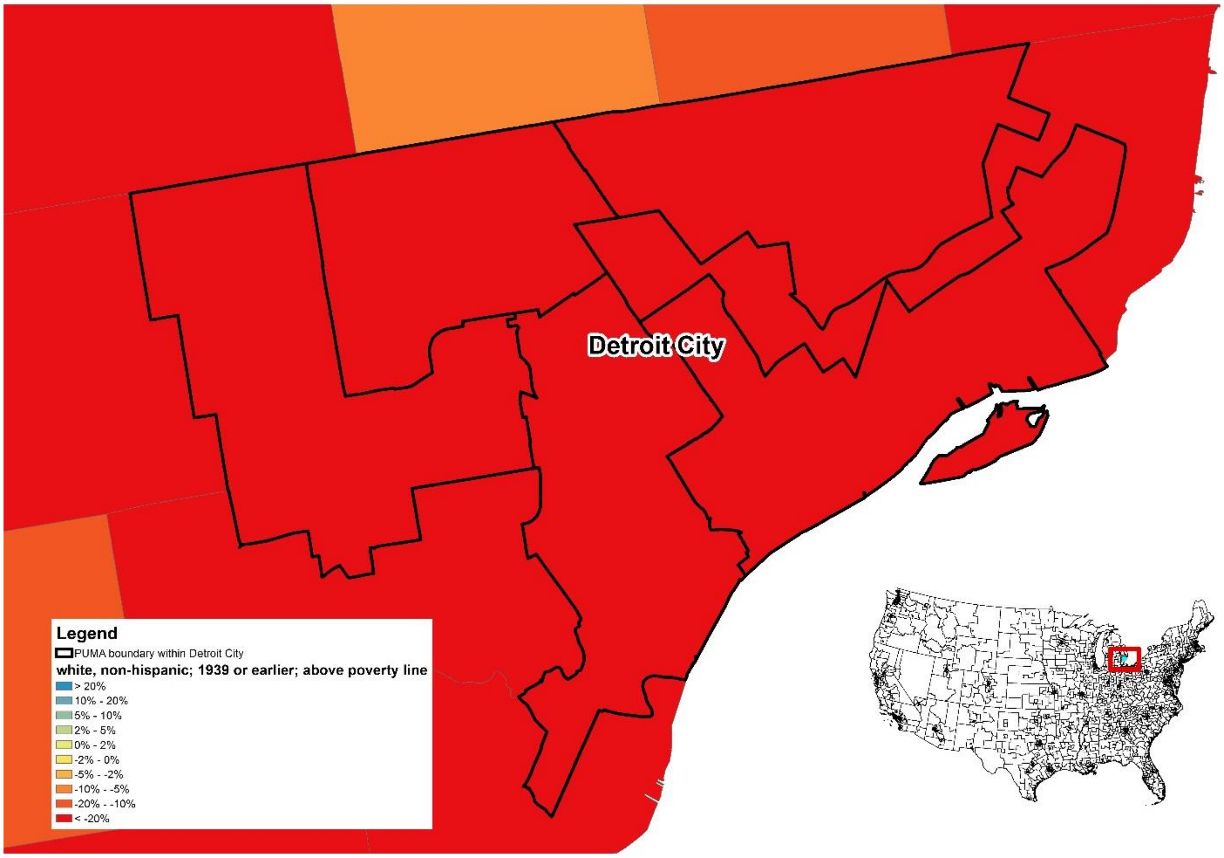


Red areas show areas where the oldest housing (built 1939 or before) have more minority and/or impoverished children than expected from regional demographic averages and available housing in each area. Blue areas around cities show suburban areas rather than the inner city.

Data source: IPUMS (Ruggles et al., 2018).

The available data do not indicate whether the older housing stock has LSLs. A further examination of regional differences and linkage to areas with known LSLs could better illuminate areas of high disparity. We developed urban maps for three cities known to have LSLs. The map for Detroit (Exhibit 2-4) shows that children in minority households and/or low-income households disproportionately live in the oldest housing units. Orange regions outside the Detroit PUMA indicate that children in minority households and/or low-income households are somewhat more likely to live in the oldest housing units, but not as frequently as children inside Detroit.

Exhibit 2-4. Percent Difference from Equal Distribution in Oldest Housing Units for Children Age 12 and Under in Detroit.

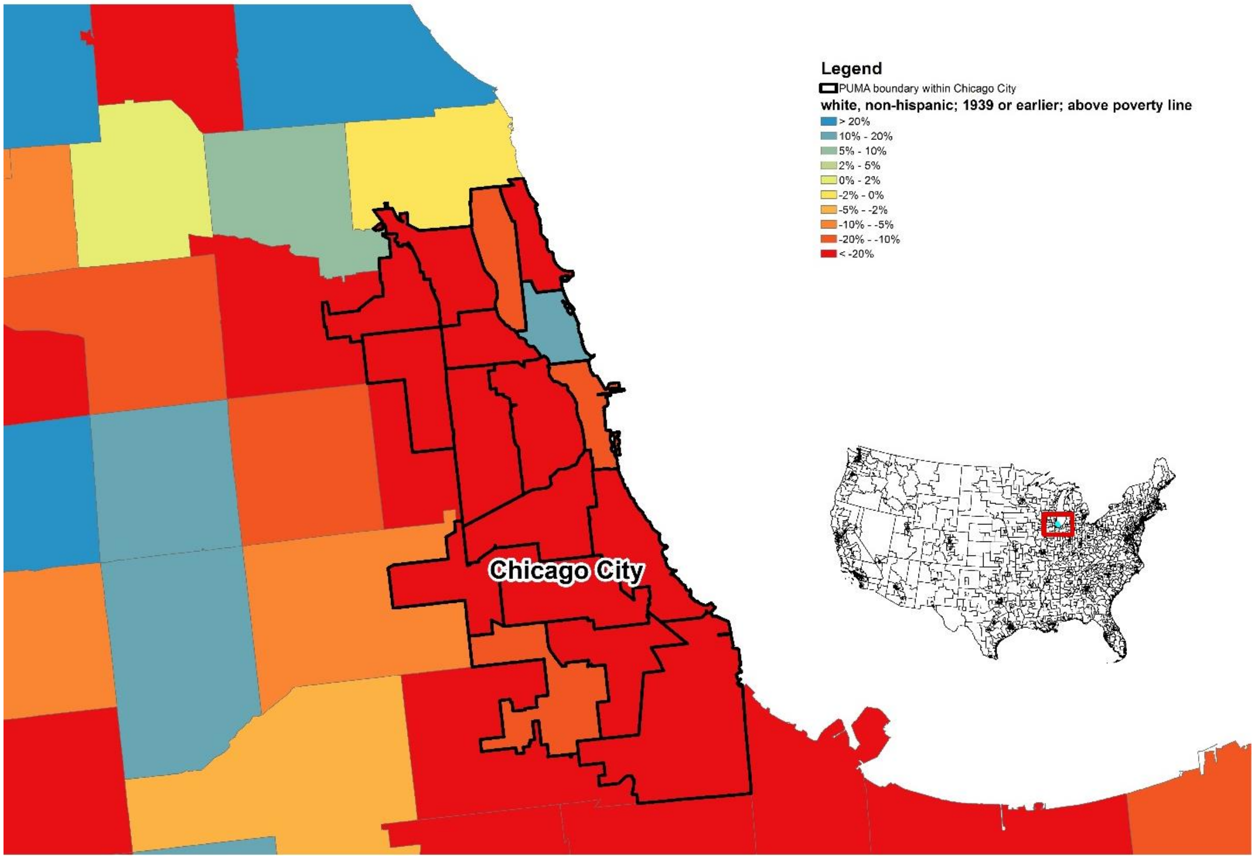


Red areas show areas where the oldest housing (built 1939 or before) have more minority and/or impoverished children than expected from regional demographic averages and available housing in each area.

Data source: IPUMS (Ruggles et al., 2018).

The map for Chicago (Exhibit 2-5) shows that children in minority households and/or low-income households disproportionately live in the oldest housing units in most areas of the Chicago PUMA. Areas of the suburban ring outside Chicago show a wide range of outcomes. In yellow, green, and blue areas, children in households that are white/non-Hispanic and above the poverty line are more likely to live in the oldest housing units. Thus, portions of the inner city indicate environmental justice concerns among children. In the suburbs, health risks may be higher among children in white/non-Hispanic households at higher incomes.

Exhibit 2-5. Percent Difference from Equal Distribution in Oldest Housing Units for Children Age 12 and Under in Chicago.



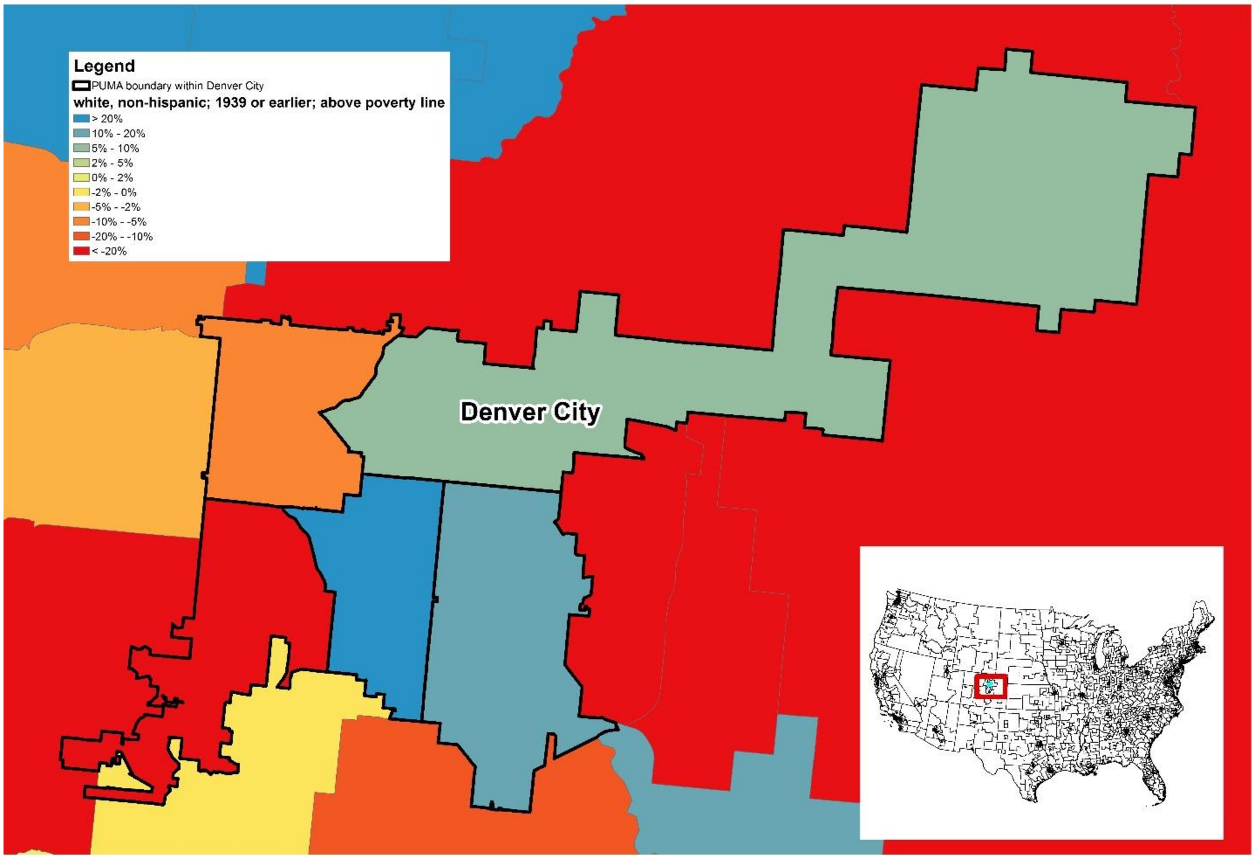
Red areas show areas where the oldest housing (built 1939 or before) have more minority and/or impoverished children than expected from regional demographic averages and available housing in each area. Blue areas around cities show suburban areas rather than the inner city.

Data source: IPUMS (Ruggles et al., 2018).

The distribution in Denver (Exhibit 2-6) is the opposite of Chicago. The central and eastern parts of central Denver have disproportionately high frequencies of children in white/non-Hispanic, higher-income households living in the oldest housing units. Children in minority households and/or low-income households disproportionately live in the oldest housing in west Denver and the surrounding counties.

Thus, all three urban areas have some regions where populations aged 12 and under of environmental justice concern disproportionately live in the oldest housing units, which may also be units with LSLs. These regions may be in the city center or in surrounding counties.

Exhibit 2-6. Percent Difference from Equal Distribution in Oldest Housing Units for Children Age 12 and Under in Denver.



Red areas show areas where the oldest housing (built 1939 or before) have more minority and/or impoverished children than expected from regional demographic averages and available housing in each area.

Data source: IPUMS (Ruggles et al., 2018).

3. Proposed LCRR Impact on Exposure

In this section, we provide a qualitative review of the proposed LCRR with respect to environmental justice concerns. EPA expects the proposed LCRR will result in health risk reductions through reducing lead concentrations in drinking water in various ways. Therefore, we begin by describing the relevant proposed LCRR elements. For each element, we identify whether the potential impact has a disproportionate effect on environmental justice populations. Then we provide an assessment of the potential impact on the baseline environmental justice concerns.

3.1 Proposed LCRR Provisions

The proposed LCRR contains several provisions intended to reduce exposure to lead in drinking water provided by CWSs or NTNCWSs. The proposed LCRR could result in new or optimized corrosion control treatment (CCT), lead service line removal (LSLR), point-of-use (POU) device installation, or combinations of these options. Furthermore, NTNCWs would have the option to replace lead-bearing material as a compliance option. All of these outcomes could reduce the concentration of lead in drinking water. In addition, there are new provisions for making LSL locations public and for PE to communicate health risk and mitigation options to at-risk customers, which may result in voluntary customer behavioral changes that further reduce health risk.

The objective of CCT installation or re-optimization is to reduce lead concentrations throughout a service area by passivation. Passivation involves coating metal pipes and fixtures to reduce chemical reactivity along their surface and, thereby, reduce the release of metals including lead.

Systems that already have CCT installed would undertake re-optimization actions under the proposed LCRR in response to either an ALE or a trigger level exceedance (TLE). An ALE occurs when the 90th percentile of tap samples exceeds the AL of 15 µg/L (i.e., more than 10 percent of tap samples in a sampling period are greater than the AL). A TLE occurs when the 90th percentile of tap samples exceeds the trigger level of 10 µg/L. By reducing the 90th percentile to at or below an ALE or a TLE, the proposed CCT revisions reduce lead exposure and health risks throughout the distribution system. Similarly, CCT requirements under the proposed LCRR that might not have occurred under baseline conditions would result in lower lead levels and health risks.

The proposed LCRR changes several LSLR requirements. It reduces the annual LSLR removal rate goal from 7 percent to 3 percent for ALEs, but it excludes partial LSLR and "tested-out" lines from counting toward the annual removal estimate.[3] It adds LSLR requirements for TLEs, but the annual removal goal will be approved by the primacy agency that regulated a system. Although the proposed changes encourage full LSLR, partial removals may still occur. A water system may own only part of a lead service line if the customer owns the line on his/her side of the property boundary. Therefore, achieving full LSLR may require customer cooperation and cost-sharing. Since the LSLR is expensive, the customer's willingness to share costs will depend on the household's ability-to-pay. Although the proposed LCRR allows partial LSLR in limited situations, such removals may be unavoidable if low-

[3] LSLs are "tested out" when sampling shows lead concentrations at or below 15 µg/L throughout the entire profile of the service line.

income households are unable to afford the cost and the system or other agencies do not subsidize LSLR for low-income households.

CWSs serving 10,000 or fewer people that have an ALE would have the option to implement a POU program in lieu of adding CCT or conducting LSLR. NTNCWSs that have an ALE would have the additional option to implement removal of all lead-bearing materials. EPA assumed that POU and removal of all lead-bearing materials would achieve lead concentrations comparable to having no lead service lines.

The LCRR proposal includes enhancements to the PE requirements, which may result in voluntary actions to replace LSLs or otherwise reduce exposure to lead in drinking water. For example, making LSL inventory information publicly available and distributing PE materials to customers with a LSLs may result in changed behavior. Behavior changes may include flushing of taps to remove water that has been in contact with an LSL, using a certified water filter, and customer removal of their portion of the LSL, which under this proposal requires the water system to remove its portion as well. Such averting behaviors will depend on several factors, including the ability to access and understand the PE materials, individual risk preferences, and the ability to afford filters or LSLR. Inventory data may also affect property values. If the valuation impact is sufficiently large, a seller may be motivated financially to remove a lead service line prior to listing a property. Low-income households may be disadvantaged in several ways, including having limited access to information (e.g., no access to online inventory maps or PE materials not provided in native languages), less ability to afford averting behaviors, and reduced wealth if property values decline.

3.2 Potential Health Risk Impacts of Rule Elements

This section provides an overview of the health risk reductions by proposed LCRR element. The assessment approach uses information from the benefits analysis described in USEPA (2019a). For the purpose of quantifying and valuing the health risk reductions, EPA derived estimates of baseline lead exposure, concentration-response relationships between drinking water lead concentrations and blood lead levels, and relationships between blood lead levels and the quantifiable child intelligence quotient (IQ) endpoint.

First, EPA developed lead concentration estimates for drinking water for seven scenarios based on tap sampling profile data for multiple systems with different combinations of lead service line and CCT conditions. There are three lead service line condition options: LSLs are present, partial LSLs are present (e.g., privately owned LSLs remain, but public LSLs have been removed), and no LSLs. Similarly, there are three CCT status options: no CCT, partial CCT[4], and representative CCT[5]. Exhibit 3-1 provides the mean lead concentrations for each scenario. Thus, differences between a system's baseline scenario (e.g., LSL present and no CCT) and the post-Rule scenario (e.g., LSL present with optimal CCT) result in exposure to different mean lead concentrations.

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[4] Partial CCT refers to samples for customers of systems that have some pH adjustment and low doses of corrosion inhibitors, but not optimized corrosion control.

[5] Representative CCT refers to samples for customers of systems that use high doses of corrosion inhibitors considered optimized.

Exhibit 3-1. LSL and CCT Scenarios, and Simulated Geometric Mean Tap Water Lead Concentrations and Standard Deviations at the Fifth Liter Drawn After Stagnation for each Combination of LSL and CCT Status

LSL Status	CCT Status	Simulated Mean of Log Lead (µg/L)	Simulated SD a of Log Lead (µg/L)	Simulated Geometric Mean Lead (µg/L)	Simulated Geometric SD a of Lead (µg/L)
LSL	None	2.92	1.37	18.62	3.95
Partial LSL	None	2.17	1.38	8.78	3.98
No LSL	None	-0.29	1.38	0.75	3.98
LSL	Partial	2.42	1.37	11.27	3.94
Partial LSL	Partial	1.67	1.37	5.32	3.93
No LSL	Partial	-0.29	1.38	0.75	3.98
LSL	Representative	1.95	1.38	7.01	3.96
Partial LSL	Representative	1.19	1.38	3.3	3.96
No LSL	Representative	-0.29	1.38	0.75	3.98

Source: USEPA, 2019a

SD = standard deviation; estimates reflect "among-sampling event" variability

The mean estimates are from a regression model of tap water lead concentration as a function of LSL presence ("LSL" or "No LSL"), LSL extent ("Partial"), CCT status, and "profile liter." Profile liter refers to liter of tap water collected following stagnation. The simulated values represent the fifth liter drawn after stagnation

EPA used the lead concentrations in Exhibit 3-1 to estimate blood lead levels in children using existing concentration-response tools. First, EPA combined the drinking water concentrations with lead exposure data from other pathways in the Stochastic Human Exposure and Dose Simulation Multimedia (SHEDS-Multimedia) model to generate estimates of daily lead intakes (in µg/day) from various environmental media (e.g., water and soil) for each year of life. Next, EPA used intakes from each medium multiplied by applicable absorption factors and summed them to estimate the total daily available lead intake. Lastly, EPA derived regression equations from the Integrated Exposure and Uptake Biokinetic (IEUBK) model to relate total available lead intakes to blood lead levels. Using this approach, EPA linked changes in water lead concentration to changes in blood lead levels, which vary by age as well as lead exposure (Exhibit 3-2). Adding or optimizing CCT reduces blood lead levels when LSLs are present. Although partial LSLR results in lower blood lead levels compared to no LSLR, full removal results in the lowest blood lead levels.

Exhibit 3-2. Modeled SHEDS-IEUBK Geometric Mean Blood Lead Levels in Children for Each Possible Drinking Water Lead Exposure Scenario for Each Year of Life

Lead Service Line Status	Corrosion Control Treatment Status	Geometric Mean Blood Lead Level (µg/dL) for Specified Year of Life[a]						
		0-1[b]	1-2	2-3	3-4	4-5	5-6	6-7
LSL	None	3.75	2.60	2.73	2.59	2.56	2.72	2.45
Partial LSL	None	2.43	1.88	1.96	1.89	1.87	1.95	1.69
No LSL	None	0.95	1.15	1.16	1.14	1.14	1.19	0.97
LSL	Partial	2.71	2.05	2.20	2.06	2.08	2.17	1.90
Partial LSL	Partial	1.86	1.58	1.65	1.60	1.60	1.66	1.43
No LSL	Partial	0.95	1.15	1.16	1.14	1.14	1.19	0.97

LSL	Representative	2.14	1.75	1.82	1.73	1.75	1.82	1.57
Partial LSL	Representative	1.51	1.41	1.45	1.42	1.40	1.46	1.24
No LSL	Representative	0.95	1.15	1.16	1.14	1.14	1.19	0.97
POU		0.95	1.15	1.16	1.14	1.14	1.19	0.97

Source: USEPA, 2019a.(Exhibit 6-24)
a. This table presents modeled SHEDS-IEUBK blood lead levels in children by year of life. The values represent the blood lead for a child living with the associated LSL/CCT status. Each year blood lead corresponding to actual modeled child is summed and divided by 7 in the model to estimate lifetime average blood lead.
b. Because of a lack of available data, blood lead levels for the first year of life are based on regression from IEUBK for 0.5- to 1-year-olds only.

Next, EPA used estimates of blood lead levels associated with baseline and post-rule CCT and LSL conditions to estimate changes in intelligence quotient (IQ). The avoided IQ loss estimates incorporate the relationship between blood lead levels and IQ (Crump et al., 2013), as shown in log linear equation below:

$$IQ\ Loss = \beta \times \ln\left(\frac{BLL_1+1}{BLL_2+1}\right),$$

where:

β = Beta estimate from Crump et al. (2013)

BLL_1 = Baseline (pre-Rule) blood lead level (µg/dL)

BLL_2 = Post-Rule blood lead level (µg/dL).

For lifetime blood lead level measurements, the value of beta is -3.25 (95% confidence interval of -4.66 to -1.83). EPA included a low-dose linearization to estimate IQ changes below the lowest blood lead level in the analysis because small changes in low levels result in large IQ loss estimates because of the functional relationship.

For the purpose of the environmental justice analysis, we derived illustrative estimates of avoided IQ losses for representative scenario changes. Exhibit 3-3 shows several pairs of baseline and post-Rule scenarios and simple estimates of avoided IQ losses in children (aged 0–7 years) based on the blood lead levels and IQ loss equation shown above. EPA's approach to estimating benefits for the proposed LCRR used a complex 35-year compliance simulation analysis (USEPA, 2019a). The simulation tool randomly selects baseline system-level lead concentrations from possible CCT and LSL scenarios and gradually reduces exposure as ALEs or TLEs occur. The tool also tracks child age cohorts and exposure levels and durations. Thus, the blood lead level estimates reflect gradual lead concentration changes and cohort aging. Our simple estimates are useful for evaluating the potential impact of the Rule on minority or low-income children relative to other children.

Exhibit 3-3. Estimates of Avoided IQ Losses in Children Associated with Baseline and Post-Rule Drinking Water Lead Exposure Scenarios.

Pre-Rule Drinking Water			Post-Rule Drinking Water			Avoided IQ Loss per Child Associated with Specified Blood Lead Level Change		
Lead Conc. (µg/L)	LSL Status	CCT Status	Lead Conc. (µg/L)	LSL Status	CCT Status	Geometric Mean	25th Percentile	75th Percentile
18.62	LSL	None	0.75	No LSL	None	1.90	1.40	2.56
18.62	LSL	None	7.01	LSL	Representative	0.97	0.72	1.29
18.62	LSL	None	0.75	No LSL	Representative	1.90	1.40	2.56
18.62	LSL	None	0.75	POU		1.90	1.40	2.56
8.78	Partial	None	0.75	No LSL	None	1.10	0.81	1.51
8.78	Partial	None	3.3	Partial	Representative	0.66	0.46	0.89
8.78	Partial	None	0.75	No LSL	Representative	1.10	0.81	1.51
8.78	Partial	None	0.75	POU		1.10	0.81	1.51
0.75	No LSL	None	0.75	No LSL	Representative	0.00	0.00	0.00
0.75	No LSL	None	0.75	POU		0.00	0.00	0.00
11.27	LSL	Partial	0.75	No LSL	Partial	1.33	0.98	1.82
11.27	LSL	Partial	7.01	LSL	Representative	0.40	0.29	0.55
11.27	LSL	Partial	0.75	No LSL	Representative	1.33	0.98	1.82
11.27	LSL	Partial	0.75	POU		1.33	0.98	1.82
5.32	Partial	Partial	0.75	No LSL	Partial	0.72	0.54	0.99
5.32	Partial	Partial	3.3	Partial	Representative	0.27	0.19	0.38
5.32	Partial	Partial	0.75	No LSL	Representative	0.72	0.54	0.99
5.32	Partial	Partial	0.75	POU		0.72	0.54	0.99
0.75	No LSL	Partial	0.75	No LSL	Representative	0.00	0.00	0.00
0.75	No LSL	Partial	0.75	POU		0.00	0.00	0.00
7.01	LSL	Representative	0.75	No LSL	Representative	0.93	0.69	1.27
7.01	LSL	Representative	0.75	POU		0.93	0.69	1.27
3.3	Partial	Representative	0.75	No LSL	Representative	0.45	0.35	0.61
3.3	Partial	Representative	0.75	POU		0.45	0.35	0.61
0.75	No LSL	Representative	0.75	POU		0.00	0.00	0.00

This table displays the avoided IQ loss per hypothetical child associated with blood lead levels at the geometric mean, 25th percentile and 75th percentile. This table assumes the hypothetical child spends their entire life in either the pre-rule or the post-rule drinking water concentration in the row. These calculations use the BLLs summarized in **Error! Reference source not found.** of the proposed LCRR EA (USEPA, 2019a)

Exhibit 3-4. Illustrative Estimates of Avoided IQ Losses

Baseline Scenario	Post-Rule Scenario	Avoided IQ Loss, Lower Bound	Avoided IQ Loss, Upper Bound
LSL present, no CCT	LSL present, Representative CCT	0.84	1.35
LSL present, Partial CCT	LSL present, Representative CCT	0.34	0.54
LSL present, Representative CCT	Partial LSL, Representative CCT	0.39	0.73
LSL present, Representative CCT	No LSL	0.79	1.55
Partial LSL, no CCT	Partial LSL, Representative CCT	0.58	1.01
Partial LSL, Partial CCT	Partial LSL, Representative CCT	0.22	0.42
Partial LSL, Representative CCT	No LSL	0.37	0.82

Source: Illustrative estimates of avoided IQ loss based on the corresponding age-based blood lead levels in Exhibit 3-2 and the IQ loss function. Lower and upper bound estimates reflect the lowest and highest differentials across the age-based blood lead levels.
LSL = lead service lines; CCT = corrosion control treatment

Based on the illustrative estimates of avoided IQ loss, it seems that the largest IQ impacts will accrue to systems with full LSLs that implement either CCT or LSLR (or POU in lieu of either CCT or LSLR). An important distinction between CCT and LSLR is that the CCT impacts will accrue to children in all customer households that have LSLs, but the LSLR impacts will only affect the subset of households where LSLs are removed. Another important distinction is that LSLR impacts are irreversible, whereas leaving LSLs in place results in some risk that future water treatment system upsets that adversely affect water quality could temporarily increase lead concentrations.

Therefore, the environmental justice implications for minority or low-income children through age seven are somewhat mixed. CCT addition or optimization is more likely to uniformly benefit an entire service population regardless of income or minority status. Post-Rule blood levels will remain slightly higher for customers who have partial or full LSLs compared to customers who do not have a LSL. Furthermore, the children in households with partial or full LSLs remain at risk of higher lead exposure in the event of a system upset that causes scale removal. Conversely, LSLR strategies are more likely to benefit children in households that can afford to pay the private costs of full line removal, which may not be affordable to low-income households.

3.3 Potential Effect of Proposed LCRR on Baseline Environmental Justice Concerns

As noted in Section 2, case study data and national demographic data indicate the potential for a baseline environmental justice concern of disproportionate exposure to lead in drinking water among minority populations and low-income households that live in older housing stock. Older housing stock is more likely to have LSLs, which tend to increase lead concentration based on the mean estimates shown in Exhibit 3-1. In addition, older housing stock is more likely to have lead paint than newer housing units. Thus, minority or low-income system service populations living in older housing units have higher lead exposure risk from both drinking water and lead paint sources. This section addresses whether the proposed LCRR mitigates or exacerbates this baseline environmental justice concern.

Exhibit 3-1 shows that the higher lead mean concentrations occur at systems with LSLs. Systems with higher mean concentrations also have a higher likelihood of exceeding the ALE or TLE. Therefore, it is likely that the systems implementing the incremental CCT and LSLR changes under the proposed LCRR are largely those with LSLs. Thus, the proposed LCRR likely targets systems that serve households of environmental justice concern for health risk reductions.

EPA's economic analysis of the proposed LCRR provides limited information to assess whether there are disproportionate impacts on populations of concern. It does not contain sufficient spatial information to evaluate whether reductions in lead exposure occur in areas with disproportionate numbers of populations of concern. Benefits estimates reflect the assumption that risks at the entry point level are uniform throughout a service area, which may not be the case if only part of the service area has LSLs and/or more prevalent lead-bearing materials. The quantitative analysis suggests that IQ impacts of CCT addition or re-optimization will be greater for customers with LSLs compared to those with partial or no LSLs. Nevertheless, the proposed rule blood lead levels will likely be higher among customers who continue to have partial or full LSLs than those without lead lines.

4. Conclusions

This section provides a summary of the environmental justice implications of baseline conditions and the potential effect of the proposed LCRR.

4.1 Baseline Conditions

Based on literature search and analysis of national income and housing age data, population groups of concern (e.g., minority and low-income populations) appear to be disproportionately exposed to the risks of lead in drinking water delivered by CWSs. In areas where lead in drinking water may increase blood lead levels in children, social disadvantage has been a risk factor (see Section 2.4). Among children, this risk may come from a higher-than-expected proportion of children in low-income households living in older housing that may have LSLs, lead solder, and leaded plumbing components and fixtures (see Section 2.5).

Older housing also contributes to the cumulative risk of lead exposure through lead paint and contaminated soil. Individuals exposed to lead through these sources may be at a higher risk of adverse health outcomes when lead concentrations in drinking water increase.

4.2 Proposed Rule Impact

We evaluated the environmental justice implications of the proposed LCRR from two perspectives. First, we evaluated whether the Rule provisions alone – regardless of baseline environmental justice concerns – would disproportionately affect minority or low-income populations. Second, we evaluated whether the proposed LCRR provisions could be expected to mitigate or exacerbate baseline environmental justice concerns.

Regarding the first evaluation, we determined that some current rule provisions would not disproportionately affect environmental justice populations. In particular, provisions such as CCT changes or long-term POU programs that reduce health risks for the entire service population regardless of minority or income status do not disproportionately advantage or disadvantage minority or low-income populations. Other provisions, however, may result in disproportionate health risk reductions among higher-income populations. These include LSLR programs that require customers to pay a portion of the removal cost and provisions that could lead to voluntary averting behaviors. To the extent averting behaviors require household expenditures, low-income households may be less able to afford behavioral changes that reduce their health risks.

For the second evaluation, we combined the impacts from the first evaluation with the baseline finding that minority populations or low-income populations may be more likely to live in housing with LSLs. EPA's analysis of tap samples indicates that systems with LSLs are likely to have higher baseline mean lead concentrations. If higher baseline lead concentrations are also likely to result in ALE or TLE and subsequent efforts to reduce lead risks, then we can conclude that the proposed LCRR in general targets the higher baseline health risks among environmental justice populations.

The extent to which the realized reduction in health risks mitigates baseline concerns depends on which provisions systems pursue (e.g., CCT changes or LSLR; EPA's economic analysis for the proposed LCRR indicates that CCT changes account for a majority of health risk reduction benefits). This result indicates the potential for the proposed LCRR to mitigate disproportional baseline risks borne by low-income and minority populations.

It is important to reiterate that CCT changes could result in uneven blood lead levels among a service population in which some households have LSLs and others do not. Furthermore, households with LSLs also have long-term risks of lead concentration increases in the event of a corrosion control treatment changes. Therefore, the provisions of the proposed LCRR that best address baseline environmental justice concerns do not completely mitigate baseline risks.

Conversely, any provisions that depend on affordability may exacerbate environmental justice concerns among low-income households that have higher baseline health risks. LSLR substantially reduces health risks in an irreversible way (assuming a filter completely mitigates short-term lead releases after removal). Only a fraction of the service population benefits from removal – the proposed mandatory annual removal rate is 3 percent.

4.3 Overall Environmental Justice Conclusion

Exhibit 4-1 provides a summary of the environmental justice analysis for the proposed LCRR. In evaluating baseline exposure to lead in drinking water, data indicate that the possibility of a disproportionately high and adverse human health risk among minority populations and low-income populations exists. Higher-than-expected proportions of children in minority households and/or low-income households live in housing built during decades of higher LSL usage. The proposed LCRR seeks to reduce the health risks of exposure to lead in drinking water provided by CWS and NTNCWS. Because systems with LSLs are more likely to have an ALE or TLE and, therefore, engage in actions to reduce lead concentrations, the proposed LCRR should mitigate the baseline environmental justice concerns.

The proposed LCRR, itself, is not expected to have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. The proposed revisions should result in CCT changes at systems with higher baseline lead concentrations. It increases the level of health protection for all affected populations. The LSLR provision may be less likely than the CCT provision to address baseline health risk disparity among low-income populations because LSLR may not be affordable for low-income households. The benefit-cost analysis of the Rule indicates that CCT changes will account for most of the benefits. Therefore, health risk reduction benefits will be more uniformly distributed among populations with high baseline health risks, including minority and low-income households. Thus, the proposed LCRR meets the intent of the federal policy requiring incorporation of environmental justice into federal agency missions.

Exhibit 4-1. Summary of Environmental Justice Evaluation Topics, Methods, and Findings

Evaluation Topic	Evaluation Method	Findings
Are population groups of concern (e.g., minority and low-income populations) disproportionately exposed to lead and copper in drinking water delivered by drinking water systems?	Case study of blood lead levels and minority status Statistical analysis of child income, minority status, and housing vintage (proxy for LSLs)	Higher blood lead levels observed among minority populations Higher proportion of low-income children in older housing likely to have LSLs
Are minority and low-income populations disproportionately affected by the LCRR?	Illustrative estimates and discussion of health risk reductions for Rule provisions	System-wide changes that benefit all customers will also benefit minority and low-income populations Household-level changes that depend on ability-to-pay will leave low-income households with disproportionately higher health risks
Do the LCRR effects create or mitigate baseline environmental justice concerns?	Qualitative discussion of how revisions might affect minority or low-income households with baseline disproportionate risk	In general, the proposed LCRR should reduce health risks primarily at systems with LSLs, which could address baseline disproportionate risk

4.4 Federal Funds for Water System-Owned and Customer-Owned LSLR

Financial assistance programs are available to provide funding for replacement of the customer-owned portion of an LSL. There are many federal programs that may be used to fund LSLR programs. The list and descriptions of the programs below come from USEPA (2019b, pp 26-17).

- **Drinking Water State Revolving Fund (DWSRF):** The DWSRF offers below-market-interest financing and funding opportunities for LSLR. Through the DWSRF Program, EPA allocates annual capitalization grants to states. The funds include set-asides that states may elect to use for drinking water program management and activities. The balance, along with a 20 percent state match, is placed into a dedicated loan fund to finance eligible water system infrastructure improvement projects (USEPA, 2018a). EPA's DWSRF annual allocations for fiscal year 2018 totaled $1.057 billion. States are providing funding from their DWSRF to facilitate LSLR projects and are taking steps to modify their DWSRF programs to prioritize LSLR.
- **Water Infrastructure Finance and Innovation Act (WIFIA):** The WIFIA established a program that provides funds to eligible water projects through long-term, low-cost supplemental loans for regionally and nationally significant projects (USEPA, 2016b). In fiscal year 2018, 39 projects in 16 States and Washington, D.C. were selected and invited to apply for WIFIA loans; 12 of these are to reduce lead or other contaminants in drinking water For example, American Water Capital Corporation in St. Louis, MO, was invited to apply for $84 million in WIFIA loan funding to support its project to replace approximately 100 miles of main and adjacent customer-owned LSLs (USEPA, 2018b). In 2019, the EPA announced the availability of $6 billion for WIFIA loans and once again prioritized projects that reduce exposure to lead.
- **Water Infrastructure Improvements for the Nation (WIIN) Act:** Under the 2016 WIIN Act, three new grant programs were established related to reducing lead in drinking water (assistance for small and disadvantaged communities, reducing lead in drinking water, and lead testing in school and child care drinking water program) (USEPA, 2019c). In 2017, $100 million was

approved for communities with a federally declared emergency relating to public health threats associated with lead or other contaminants in drinking water (USEPA, 2017b).

- **Community Development Block Grants (CDBG)**: The Department of Housing and Urban Development has administered the CDBG program since 1974 and provides resources for community development needs. CDBG-funded projects must benefit low- and moderate-income populations, prevent or eliminate slums or blight, or address urgent community development needs, particularly those that present an immediate threat to public health or welfare of the community for which other funding is not available (HUD, no date).

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